THE JOURNAL OF
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

(Including Transactions)

Volume 36 NOVEMBER 1914 Number 11

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COMING MEETINGS OF THE SOCIETY

November 10, *New York City.* Paper: The Development of the By-Product Gas Producer Industry in Europe, by Arthur H. Lymn, London, England, inventor of the Lymn process. Informal dinner, 6.30 p.m.

November 18, *Boston, Mass.* Meeting under the auspices of the Boston Society of Civil Engineers. Address: The Commission-Manager Form of Government and its Relation to the Engineering Profession, by Henry M. Waite, City Manager, Dayton, Ohio.

November 18, *New Haven, Conn.* Fall meeting, Mason Laboratory of Mechanical Engineering, Sheffield Scientific School, Yale University. Subject: The Applications of Electricity in Manufacturing. Afternoon session, 3.00 p.m., papers by Chas. F. Scott and others; evening session, 7.30 p.m., addresses by James Hartness, President, Calvin W. Rice, Secretary, and continuation of afternoon discussion. Dinner, 6.00 p.m., in Yale Dining Club.

November 19, *St. Paul, Minn.* Paper: Coal Testing, by V. H. Roerich.

November 20, *Chicago, Ill.*, La Salle Hotel. Subjects: A New High-Pressure Safety Boiler, W. H. Winslow, president, Winslow Safety High-Pressure Boiler Co.; Boiler Furnace Efficiency, Joseph W. Hays, combustion engineer; Boiler Efficiency Meters and European Boiler Practice, W. A. Blonck, consulting engineer; Mechanical Filters, Walter H. Green, chief engineer, International Filter Co. A dinner will precede the meeting, commencing at 6.30 p.m.

November 21, *Philadelphia, Pa.* Joint meeting with Engineers Club. Paper: Bituminous Coals, Predetermination of their Clinkering Action by Laboratory Tests, by F. C. Hubley, assistant engineer of tests, American Bridge Co.

Annual Meeting, December 1–4, *New York City.* For program see p. III.

December 8, *San Francisco, Cal.* Paper: A Novel Method of Handling Boilers to Prevent Corrosion and Scale, by Allen H. Babcock, Consulting Electrical Engineer, Southern Pacific Company.

THE JOURNAL OF
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Volume 36 — November 1914 — Number 11

THE ANNUAL MEETING

DECEMBER 1-4, 1914

THE feature of the professional sessions will be the all-day session on December 3, on the engineer in public service, which is in line with the wide-spread movement among engineers to devote their special training to public problems. There will also be five sessions on miscellaneous subjects. The exhaustive report of the Committee on Boiler Specifications will probably be ready for discussion at the opening session. On Wednesday evening it is expected that the John Fritz Medal will be awarded to Prof. John E. Sweet, Honorary Member and Past-President, to whom more than to any other living man the formation of the Society is due. Altogether the program is one of the strongest and most interesting in recent years.

TENTATIVE PROGRAM

Tuesday Evening, December 1, 8.30 p.m.

President's Address, by James Hartness
Report of Tellers of election of officers
Introduction of President-elect
Reception by the Society to the President, President-elect, ladies, members and guests in the rooms of the Society. Music and refreshments

Wednesday Morning, December 2, 10.00 a.m.

Business meeting. Reports of the Council and Standing Committees. Reports of Special Committees.

PROFESSIONAL SESSION

FLOOR SURFACES IN FIREPROOF BUILDINGS, Sanford E. Thompson
(CONTRIBUTED BY THE SUB-COMMITTEE ON INDUSTRIAL BUILDING.)

REINFORCED-CONCRETE FACTORY BUILDINGS, F. W. Dean
(CONTRIBUTED BY THE SUB-COMMITTEE ON TEXTILES.)

Wednesday Afternoon, 2.00 p.m.

PROFESSIONAL SESSION

MEASURING EFFICIENCY, H. L. Gantt

STANDARDIZATION IN THE FACTORY, C. B. Auel
(CONTRIBUTED BY THE SUB-COMMITTEE ON MACHINE SHOP PRACTICE.)

OPERATION OF GRINDING WHEELS IN MACHINE GRINDING, Geo. I. Alden

FRICTION LOSSES IN THE UNIVERSAL JOINT, P. F. Walker and W. J. Malcolmson

RAILROAD SESSION (SIMULTANEOUS)

STEAM LOCOMOTIVES OF TODAY: Report of the Sub-Committee on Railroads

Wednesday Evening, 8.30 p.m.

It is expected that the John Fritz Medal will be awarded to Prof. John E. Sweet, Honorary Member and Past-President of the Society.

Following this will be an address of unusual interest, the subject of which cannot as yet be definitely announced.

Thursday, December 3

All-day session, commencing 10.00 a.m., on Engineering in the Administration of a City. Papers contributed by the Committee on Public Relations. The session will be opened by John Purroy Mitchel, Mayor of the City of New York, and contributions have been arranged for upon a wide variety of subjects such as is indicated in the following tentative list: The collection and disposal of refuse from an engineering standpoint and the utilization of municipal wastes; the handling of sewage sludge; the training of municipal employees; the cleaning of public buildings; the future of the police arm presented from the engineering side; the problem of organization as related to the highway department; controlling factors in municipal engineering; cleaning filter sands; the design and operation of a municipal electric light plant; and municipal colleges in Germany.

Thursday Afternoon, 2.00 p.m.

IRON AND STEEL SESSION (SIMULTANEOUS)

FACTORS IN HARDENING TOOL STEEL, John A. Mathews and Howard J. Stagg
(CONTRIBUTED BY THE SUB-COMMITTEE ON IRON AND STEEL.)

STANDARDIZATION OF CHILLED IRON CRANE WHEELS, F. K. Vial
(CONTRIBUTED BY THE SUB-COMMITTEE ON HOISTING AND CONVEYING.)

THE MECHANICAL ELIMINATION OF SEAMS IN STEEL PRODUCTS, NOTABLY STEEL RAILS, R. W. Hunt

TOPICAL DISCUSSION ON ALLOY STEELS

Thursday Evening, 7.00 p.m.

Dinner dance, Hotel Astor

Friday Morning, December 4, 10.00 a.m.

PROFESSIONAL SESSION

A RATE-FLOW METER, H. C. Hayes

A NEW VOLUME REGULATOR FOR AIR COMPRESSORS, Ragnar Wikander

PHYSICAL LAWS OF METHANE GAS, P. F. Walker

LABORATORY FOR TESTING AND INVESTIGATING LIQUID FLOW METERS, W. S. Giele

THE CLINKERING OF COAL, Lionel S. Marks

ANNUAL MEETING PAPERS

ON the preceding page is given a tentative program for the Annual Meeting with the papers listed in so far as it is possible to announce them at the date of going to press. Besides the papers listed there will be a series of papers for the all-day session on Thursday upon the general subject of Engineering in the Administration of a City. These latter papers are now in the hands of the Committee on Meetings and full announcement of them will be made as early as possible.

The chief interest of the Annual Meeting will undoubtedly center about this Thursday session. The individual papers are such as will attract attention and a large attendance is expected of engineers from different parts of the country who are interested in this rapidly growing phase of the work of the engineer.

All of the papers for the Annual Meeting will be published in pamphlet form in advance for distribution and copies of any or all of them will be sent to members prior to the meeting upon request. In so far as possible abstracts to be presented are given below and it may be assumed that the list is practically complete as published, with the exception of the papers for the Public Service meeting. The papers are given in the order in which they appear in the program.

FLOOR SURFACES IN FIREPROOF BUILDINGS

By Sanford E. Thompson

No one type of floor surface is adapted to all conditions, and having selected the proper type, the choosing of the materials and the manner of the construction govern to a large extent the durability of the surface.

It is the purpose of the paper to discuss briefly the different kinds of floor surfaces; indicate the types of construction which may be selected under different conditions; give approximate costs of various floor surfaces; describe tests and investigations of granolithic construction made in connection with the new buildings for the Massachusetts Institute of Technology, and present recommendations for granolithic construction.

Summarizing the discussion on the characteristics of floors:

Granolithic. As ordinarily laid in buildings, granolithic or concrete surfaces are subject to dusting and under heavy traffic, such as trucking, are liable to serious wear. On the other hand, experience with first-class construction and tests of actual floors show that it is possible, by proper selection of the aggregates and expert workmanship, to reduce the dusting to an insignificant amount and to produce a surface hard enough to stand even severe wear.

Granolithic with Ground Surface. Experimental surfaces, together with laboratory tests made as a check, show that a pleasing surface, approaching terrazzo in appearance and fully as durable under foot traffic, can be obtained by placing granolithic with scarcely any troweling, and then grinding the surface just enough to expose the grains of sand and stone.

Linoleum. The hardness characteristic of granolithic finish is overcome by covering the surface with battleship linoleum.

Hardwood Floors. Floors of maple, birch, beech, oak or long-leafed Southern pine, are used most largely for offices, class-rooms, or lecture rooms, and in many of the older colleges for laboratories and halls. A wood surface, however, is not usually considered entirely satisfactory either in general appearance or in wearing qualities.

Terrazzo. This is being largely used, especially in the newer office buildings and in institutions, for corridors and halls. It is also a satisfactory material for laboratories.

Marble Mosaic. Mosaic consists of small squares of marble laid on the cement bed, something like terrazzo.

Magnesium Composition. When laid with great care, composition is satisfactory and durable material. Floors six or eight years old have been examined and show satisfactory wear.

Essentials of Granolithic Construction. Aggregates should contain no dust but should consist chiefly of particles ranging from $^1/_{16}$ in. to $\frac{1}{2}$ in. in size.

Proportions with first-class materials should be one part cement to two parts aggregate.

This mixture should be of such consistency that it will not flow but will hold its shape in a pile without settling.

A perfect bond must be made with the base concrete either by laying the granolithic before the concrete has set, or else roughening surface and providing a bond of neat cement paste.

Laying must be done at moderate temperatures, avoiding temperatures below 50 deg. fahr.

Troweling should be thorough but no excess water should be brought to the surface. A hard, dense surface rather than a smooth, glossy surface should be the aim.

The surface should be kept wet for at least ten days to two weeks after laying.

REINFORCED-CONCRETE FACTORY BUILDINGS

By F. W. Dean

This paper presents the advantages of the use of reinforced concrete for the use of factory buildings, such as fire-resisting qualities, great window area, and good lighting, and also some of the disadvantages. It also points out that regular mill construction buildings have shown their fire-resisting qualities when properly designed. The best methods of finishing the floors are discussed and also the application of wood as a wearing floor above the concrete. The difficulties of fastening shafting hangers and machinery are brought out and the extra cost of drafting in consequence of this, as well as the great care required in making provision for everything to be installed. The different methods of constructing floors and the different forms of ceilings are taken up and also the relative costs of concrete and regular mill construction buildings.

MEASURING EFFICIENCY

By H. L. Gantt

The author contends that the attempt of the accountant to furnish the financier with easily obtainable measures of efficiency has not only been a failure, but that the attempt to use as measures of efficiency the criteria which he has provided is one of the most serious causes of inefficiency with which the practical manager has to contend.

Fortunately for industry at large, the first fallacy, namely that it is necessary to have low wages in order to get low costs, is rapidly falling into disrepute; but the second, namely, that the ratio of "non productive" to "productive labor" as a measure of efficiency is still strongly and almost universally held by accountants and financiers. This fallacy, on account of its widespread acceptance, is responsible for more inefficiency than almost any other cause.

Inasmuch as the object of increasing the efficiency of an industrial operation is to reduce the cost of that operation, the only real measure of the efficiency with which the operation has been performed is found *in the effect on its cost.*

The only reliable indication, then, of the efficiency of a plant is furnished by the detail shop cost of the operations performed.

Before any great progress in the solution of our industrial problems can be made, the two fallacies above referred to must be abandoned, for they not only directly hamper the operating executive in his efforts to promote efficiency, but impose upon him conditions that make it almost impossible for him to secure the proper coöperation of his employees, and are thus indirectly the cause of much of our industrial unrest.

STANDARDIZATION IN THE FACTORY

By C. B. Auel

A brief outline is given in this paper of the ways and means employed by a large electrical establishment in their work of standardization.

Drawings: It was formerly the custom to make all drawings as complete and self-contained as possible. Opposite each item a note was placed specifying the material required to manufacture it. When drawings for new apparatus were made and any of the old parts could be used, these parts were shown again on the new drawings in complete detail, so that the workmen would not have to refer to any other drawing. This method was found to involve more and more a duplication of drafting and clerical work and the scheme of making elemental drawings with one piece on a drawing was next considered; but, while this insured accuracy in duplication, it had the disadvantage of too many drawings to handle. A compromise arrangement was therefore adopted, consisting of a natural grouping of pieces or parts on a single drawing. Each piece is assigned an item number and a list of the material involved is located conveniently on the drawing arranged numerically according to item numbers.

Manufacturing Information: All apparatus and parts are built to so-called manufacturing information, which consists of a specification setting forth the drawings to be worked to, with a list of the various kinds and amounts of material required. Copies of such portions of these specifications and drawings as pertain are issued to all departments having work to do in connection with an order, and these specifications are closed when the order is completed.

Specifications and Shop Processes: When either the quality or the importance of the items warrant, specifications are carefully prepared for the purchasing and the inspection departments who use them in the purchase and the subsequent inspection of such materials. Another equally important line of work consists in the development of manufacturing processes and formulae which, when standardized, are recorded in permanent form and issued to the various manufacturing departments involved. In this way uniformity in product is assured, there is no needless repetition of lessons or experiences previously learned, and the company is made independent of any individual's knowledge.

Standardization: Owing to the obvious need for having certain standard sizes and kinds of materials, the first steps in standardization naturally fell to the drafting department. Later a standards division of the engineering departments and a Standards Committee were created, whose functions are the standardization of existing materials and parts. The work of the Standards Committee has been varied in the extreme, such matters having been successfully handled as punched circular washers, thumb and wing nuts, oil-hole covers and hinges, furniture, anchor holes in bearings, wood handles, sizes of tap drills, stresses in eye-bolts, thickness of babbitt in bearings, liners, trucks, etc.

Cutting tools have been standardized as well as die and jig parts, die shoes, punches and punch holders, punch and stripper plates, jig boxes and bushings, drill press shanks, etc. Endeavor has been made to place on working drawings the allowable variations from drawing dimensions for standard parts.

Allowances for Expense Materials: The monthly consumption of various expense materials, such as oils, greases, waste, incandescent lamps, janitor's supplies, etc., has been estimated for the individual manufacturing departments, based on normal production. From these investigations, allowances have been set on each item and a department is permitted to draw from the storehouse on requisitions up to its allowance. Anything in excess must first receive the approval of the superintendent of the department.

Handling Materials: Attention has been given to the economical handling of the smaller materials and the paper describes the various devices employed—packing of small pieces in cloth bags, metal tote boxes of special design, etc.; and for transportation, the use of trucks of various types, especially electric storage trucks.

Safety Methods: Well-defined steps have been taken for the systematic introduction of safety methods and devices. A supervisor of safety appliances was appointed and a monthly appropriation issued to cover the cost. No new tools are erected nor old tools replaced without adequate safeguards, by which means dangerous tools or equipment are gradually eliminated. An analysis of the accidents for the past year shows but three-tenths of 1 per cent to have been caused by the absence of safeguards. A campaign of education is conducted to reduce accidents due to carelessness.

Inactive Materials: All stock ledgers are regularly scrutinized by the storekeeping department and slow-moving or inactive items submitted to a materials disposition depart-

ment that investigates not only the cause of the inactivity but at the same time endeavors to dispose of the material to the best advantage.

OPERATION OF GRINDING WHEELS IN MACHINE GRINDING

By Geo. I. Alden, Worcester, Mass.

Long experience in the use of grinding wheels has developed facts in regard to their action which, however, have been stated only as empirical rules. Such rules are easily forgotten or confused by operators because they are not related in any obvious way to any known principles by which results may be predicted. For example, what is the effect upon a wheel of increasing the speed of work, or of increasing the diameter of the work, or of diminishing the diameter of the wheel?

This paper gives an analysis of the action of the wheel when in operation. It shows the distinction between the radial or real depth at which the wheel cuts and the depth which the abrasive grain in the wheel cuts into the material being ground. This latter depth is termed the "grain depth of cut," which is the *controlling factor* in securing the correct working of the wheel.

When a grinding wheel is working properly, the abrasive grain of the wheel may be considered as cutting small chips from the work, and the surface of the work as cutting or wearing away the bond of the wheel. It is quite evident that the greater the grain depth of cut, the more effective will be the action of the work upon the bond of the wheel. So long as the bond is being worn away just as fast as the abrasive grains of the wheel are being worn down, the wheel will continue to work well. If the bond is cut away too rapidly, the wheel will appear too soft, and will wear away too rapidly. If the cutting grains wear down faster than the bond is cut or worn away, the face of the wheel will become glossy, and the wheel will not cut freely. These considerations lead directly to the conclusion that the action of a given wheel on a given kind of work is almost entirely dependent upon the grain depth of cut. If the grain depth is too great, the wheel wears away too rapidly. If the grain depth is too small, the wheel may glaze. It is therefore important to know how the grain depth of cut may be regulated. Further analysis in the paper leads to the following conclusions:

a Other factors remaining constant, increase of work speed increases grain depth of cut, and makes a wheel appear softer

b Similarly, a decrease of wheel speed increases grain depth of cut

c Similarly, diminishing the diameter of the grinding wheel increases grain depth of cut, and increasing the diameter of the wheel decreases grain depth of cut

d Similarly, making the diameter of work smaller increases grain depth of cut. Conversely, making the diameter of work larger makes grain depth of cut smaller

In applying the principle that grain depth of cut is the main factor, the correct relative speeds of work and of wheel must be found by trial for each wheel and each kind of work. When this has been done, the principle of grain depth of cut will enable one to know the direction in which to make the changes of work speed or wheel speed, to adapt the wheel to changes in its own diameter, or to other sizes of the same kind of work.

In the foregoing it is assumed that the object of grinding is to remove stock rapidly. Often, however, the character or finish of a ground surface is of primary importance. From the point of view of grain depth of cut, a smooth surface by grinding would be obtained if the grain depth of cut were very small, and therefore the work speed should be relatively slower for finishing than for roughing. That the bond may be worn away by a very small grain depth of cut, a softer wheel would be used for fine finishing than for roughing. A very hard glazed wheel may sometimes produce a mirror-like surface on the work; the action in this case being a sort of burnishing process.

The paper concludes with the derivation and application of a formula for the grain depth of cut. Several examples are worked out and a table of arcs of contact of wheel and work for a limited range of diameters is given, also a table of values of one of the factors in the formula for grain depth of cut.

FRICTION LOSSES IN THE UNIVERSAL JOINT

By P. F. Walker and W. J. Malcolmson

For three years two standard makes of universal joints of the type employed in automobile transmission mechanism have been under investigation in the laboratory of the Mechanical Engineering Department of the University of Kansas. Each joint has been operated through a wide range of loads and at several speeds common in automobile service. The purpose has been to determine the loss due to friction in the joint under these varying loads and speeds and for all angles of deflection between the shafts up to the maximum for which the joints were designed. In all the tests two joints have been used, connected by a short intermediate shaft, so that power was transmitted from the shaft of one machine to the shaft of the second, which was always held in a line parallel to the first.

Account has been taken of the differences in operating conditions when the forks of the two joints connected to this intermediate shaft were assembled with the axes in the same plane and when assembled with the axes at 90 deg. Reference to the curves showing friction loss and efficiency reveals the fact that the loss with the forks at 90 deg. is practically double that found with the forks in the same plane.

Average results are presented in the form of curves representing actual loss in the joint, and from these corresponding efficiency curves are derived. For speeds from 650 to 100 r.p.m. and for loads above ¼ of that for which the joints were designed, the efficiencies are high and practically constant for each angle of deflection. These values for the maximum angles and speeds never falls below 95 per cent. The losses being practically constant when expressed as percentages of load indicates a constant coefficient of friction on the journals of the joint forks, which would be expected under conditions of uniformity in lubrication within the limits of bearing pressure appropriate to the lubricant used.

STEAM LOCOMOTIVES OF TODAY

Report of the Sub-Committee on Railroads

The first consistent and systematic plan to secure the utmost power of locomotives within given restrictions of weight

and cross-section clearance was inaugurated 20 years ago. This plan began with an eight-wheel or American type passenger locomotive, built for an eastern railroad in January 1895. This locomotive weighed 116,000 lb., with 74,500 lb. on driving wheels. It provided a tractive effort of 21,290 lb. While this locomotive was not the most powerful in passenger service at that time, it was the first of a chain of passenger locomotives leading in a connected series, by the same builders, up to and including recent designs of the Mountain type, representing the largest passenger type of present practice. This type has four-wheel leading trucks, eight driving wheels and two trailing wheels. The largest of the Mountain type weighs 331,500 lb. with 240,000 lb. on driving wheels and produces a tractive effort of 58,000 lb., or about three times the tractive effort of the first design of the series built during a period of 20 years.

In the year 1898 the engineering and railroad world was interested by the appearance of the largest and most powerful locomotive built up to that time. This was of the Consolidation type with a two-wheel leading truck and eight driving wheels. This locomotive was built in Pittsburgh and for a number of years was the largest and most powerful of its type, and the largest and most powerful locomotive in the world. Its total weight is 330,000 lb., weight on drivers 208,000 lb. and tractive effort 53,300 lb.

Today the most powerful freight locomotive has two leading and two trailing wheels and 24 driving wheels. It gives a tractive effort of 160,000 lb. and weighs 410 tons. This locomotive has hauled a train of 251 freight cars weighing 17,912 tons, exclusive of the locomotive. The total length of the train was 1.6 miles, the maximum speed attained was 14 miles per hour. This required a maximum drawbar pull of 130,000 lb. This locomotive has six cylinders and three groups of driving wheels.

Valuable comparisons in efficiency may be drawn from the best results of ten years ago and of to-day. At the Louisiana Purchase Exposition in 1904 was shown to be possible to obtain equivalent evaporation from and at 212 deg. of 16.4 lb. of water per sq. ft. of heating surface, indicating the power of locomotive boilers when forced. It was shown that when the power was low, the evaporation per pound of coal was between 10 and 12 lb., whereas the evaporation declined to approximately two-thirds of these values when the boiler was forced. These results compared favorably with those obtained in good stationary practice, whereas the rate of evaporation in stationary practice lies usually from 4 to 7 lb. of water per ft. of heating surface per hour. In steam consumption the St. Louis tests showed a minimum of 16.6 lb. of steam per i.h.p. per hr. In coal economy the lowest figure was 2.01 lb. of coal per i.h.p., the minimum figure for coal per dynamometer h.p. was 2.14 lb. These records were made after the superheater had become a factor in locomotive practice and they represent economies attained by aid of the superheater in one of its early applications. This is important in the light of the recent development of the superheater.

Voluminous records of recent investigations of locomotive performance taken from the Pennsylvania Railroad test plant at Altoona show that the best record of dry fuel per i.h.p.-hr. down to the present date is 1.8 lb. with a large number of less than 2 lb., while the best performance in dry steam per i.h.p.-hr. is 14.6 lb. with a large number less than 16 lb. A reduction of 10 per cent in fuel and 12 per cent in water is remarkable as a result of a development of 10 years. This coal performance was recorded by a Class E 6 S Pennsylvania Railroad locomotive while running at 320 r.p.m. and developing 1245.1 i.h.p. The same locomotive gave a fuel rate of 1.9 lb. while running at the same speed and developing 1750.9 i.h.p. The best water rate was given by Class K 2 S A Pennsylvania Railroad locomotive while running at 320 r.p.m. and developing 2033.1 i.h.p. These high powers indicate that the locomotives were not coddled as to output of power in order to show high efficiencies, but that high efficiencies accompany actual conditions of operation in severe service. As to power capacity expressed in terms of evaporation, it is interesting to note that the maximum equivalent evaporation from and at 212 deg. per sq. ft. of heating surface per hour on the Altoona test plant is 23.3 lb.

FACTORS IN HARDENING TOOL STEEL

By John A. Mathews and Howard J. Stagg

The paper is devoted primarily to the practical side of the art of hardening and tempering tool steel, carbon steels being considered in the first place (0.60 to 1.50 per cent carbon).

The authors explain at some length the structural variations of steels as a function of carbon content and temperature, as well as the influence of the critical ranges of temperature on the properties of steel, with particular attention to volume changes (variation of expansion with temperature). In case of overheating, the first cooled portion is hardened first, forming an unyielding shell, and a strain is set up by the slower cooling interior which may lead to cracks and ruptures.

Time of Heating: The time of heating is of extreme importance for the strength of the piece: if the heating is too fast, the temperature through the piece is not uniform, while long heating leads to the formation of abnormal size of grain and weakness of the metal. A very bad practice is quick heating in a furnace which is considerably hotter than the correct hardening temperature.

Speed of Quenching: The metal must be cooled quickly, so as to obtain martensite, which is the correct constituent of hardened steel. The authors illustrate the influence of quenching by two examples which are not however tool steels, and after mentioning, according to Benedicks, the conditions which a liquid must have to exhibit a good quenching power, proceed to report their own tests of various quenching media which included pure water, brine solutions, and various oils. The results obtained are expressed in the form of curves.

Hardness as Affected by Mass: Tests have also been made to determine the relation between hardness after quenching and mass, in the course of which it was found that the smaller the sample, the greater the hardness; and the larger the mass, the smaller the depth of hardness when quenched under similar conditions. In order to produce the same degree of hardness in a small and large section, it is necessary to heat the large section hotter than the small one.

Time and Degree of Drawing Temper: It is preferable in large or intricate pieces to draw the temper immediately after hardening. The decrease of hardness on tempering is theoretically explained and illustrated by data obtained by Professor Heyn, while for the effect of time on drawing the

temper the authors present data of their own tests which show that time at the drawing temperature has a marked effect, the general effect of drawing the temper being the more marked, the greater the initial hardness of the piece. The effect of repeated quenching on the shape of steel was studied by means of several hundred experiments and several thousand measurements (on crucible steel). There are four possible changes in shape (length and diameter) in a cylinder through expansion and contraction and under variable conditions all four were actually produced. Many different results were obtained, as where a steel expanded in length on first hardening, and contracted indefinitely thereafter on repeated hardenings, while another steel expanded in length on two hardenings and contracted on the next two. It was generally found that variable conditions gave variable results, which showed the vital importance of the steel furnished being uniform, chemically and physically. The authors conclude by a brief discussion of the qualifications of furnaces used for heating.

THE STANDARDIZATION OF CHILLED IRON CRANE WHEELS

By F. K. Vial, Chicago, Ill.

In the earlier stages of crane construction, wheels of the general design used in railroad service were adapted to crane service by adding a second flange of about the same section as that of a railroad wheel. This practice worked very well as long as the wheel loads did not exceed those used in railway service. In the heavy types of bridge cranes, however, concentrated wheel loads five times as great as occur in railroad service are required to secure the greatest economy.

The most common troubles with crane wheels are:

- *a* Wheels becoming out of round on account of unequal wear
- *b* Breaking down of metal on account of loads exceeding its bearing power
- *c* Distortion and binding of flanges on account of irregularity in gage of track
- *d* These defects in wheels produce heavy strains throughout the structure, including worn and broken propelling gears

All of these defects are not only annoying, but expensive on account of the interruption of service of important machinery.

The Griffin Wheel Company has undertaken an investigation into these various phases by testing to destruction a large number of full size wheels of various designs in the R. W. Hunt & Company's 300,000-lb. Riehle testing machine. Use was also made of a considerable number of tests made at Purdue University and at the University of Illinois.

Bearing Power of Chilled Iron on Steel Rails. The vertical load to be carried on any wheel is not limited by the capacity of the wheel, but by the carrying capacity of the rail. The bearing power of chilled iron is far in excess of that of a steel rail, and, therefore, may be neglected when considering maximum vertical loads.

The tests show that under like loads, the depression in the rail is inversely as the diameter of the wheel. The larger diameter of wheel makes a larger area of contact, which reduces the pressure per square inch.

Analysis of the Carrying Capacity of Various Rails. Tables are given to show that on a new A. S. C. E. rail the safe maximum limiting load for a 12-in. wheel is 23,000 lb., and for a 33-in. wheel, 38,150 lb. If the top of the rail is flat, 2 in. wide, the limiting load on 12-in. wheels is 78,300 lb. and on 33-in. wheels, 130,000 lb.

Relation of Diameter of Wheel to Traction. The power required for locomotion decreases as the diameter of wheel increases.

A 24-in. wheel requires 25 per cent more power than a 33-in. wheel.

A 16-in. wheel requires 68 per cent more power than a 33-in. wheel.

Relation of Diameter of Wheel to Flange Strength. The strength of flanges increases with the increase in diameter of wheel. With the same dimensions of flange and tread, the flange on a 33-in. wheel is from 26 per cent to 34 per cent stronger than the flange on a 24-in. wheel and from 62 per cent to 92 per cent stronger than the flange on a 16-in. wheel.

Relation of Flange Thickness and Tread Thickness to Flange Strength. The tests show that the relation of flange thickness to tread thickness for crane wheels should be as two is to three. Assuming the strength of a flange 1¼ in. thick and tread thickness of 1⅞ in. as 100, a flange having a thickness of 1¾ in. and tread thickness of 2⅝ in. would be 200. In other words, every ⅛ in. added to flange thickness with the relative increase in tread thickness increases the flange strength 25 per cent. Chilled iron flanges were tested to above 1,000,000 lb. horizontal pressure without breaking.

Standard Design for Crane Wheels. Various designs of 12 in. to 36 in. double flange wheels were made, giving the maximum safe vertical load and the maximum safe flange pressure for each design. Full details of each wheel are shown in the pamphlet.

THE MECHANICAL ELIMINATION OF SEAMS IN STEEL PRODUCTS, NOTABLY STEEL RAILS

By Robert W. Hunt

Increased weight of rolling stock and speed of traffic have led to increase in size of rail sections, requiring changes in the detail of rail manufacture. Under these conditions it is not surprising that new and unexpected physical weaknesses should develop in the heavier rails. One of the chief troubles has been failures through crescent-shaped pieces breaking out of the rail flanges, followed by at least one, and in many cases several, ruptures across the whole section of the rail. Investigation shows that in practically every instance of such failure there was a more or less pronounced seam running longitudinally in the bottom of the rail near its center. This seam occurs at the top of the curve of the crescent-shaped break and is undoubtedly the point at which the fracture starts.

As a result of an investigation of the subject, T. H. Mathias, assistant general superintendent of the Lackawanna Steel Company, determined that the most certain way of getting rid of seams was to remove that portion of the metal which contained them. He reasoned that the primary causes of seams existed in the ingots and probably were incident to the casting of the ingots. The surfaces of ingots display disk-like apertures, due to entrapped air, which in rolling could easily be elongated into dangerous seams. It was

demonstrated, also, that the surfaces of the ingots are decarburized to the extent of eight to ten points carbon and to a depth of $^5/_{16}$ in., which must be detrimental to the finished product.

The removal of the surface metal is effected by a hot sawing, or milling operation during the process of rolling. The ingot is first reduced to a point where the product is 75 per cent finished, in the form of a partially shaped bar 60 ft. long, when it is entered between two pinch rolls with the flange side up and forced between two milling saws. A second set of rolls pulls on the bar and aids in holding it in line for the milling operation. The milling saws are 5 ft. in diameter with an 8-in. face and revolve at a peripheral speed of 2500 ft. per min. Metal is removed from the top and bottom of the bar, the main object being to eliminate the seams from the central portion of the bottom of the rail which has been the starting point of the moon-shaped failures, and from the top or bearing surface of the head of the rail.

A RATE-FLOW METER

By H. C. Hayes, Cambridge, Mass.

The meter described is designed to be used for recording a variable flow of water, such as boiler feedwater, where there are sudden fluctuations in velocity head, large changes in temperature, and where low rates of flow have to be recorded. The meter operates through the relation which exists between the velocity of a moving fluid and the change of pressure in a direction perpendicular to the direction of flow.

The author discusses several constructions which might be given to a meter working on this principle. If the conduit is bent in a circular arc, the meter will work well for measuring large values of velocity, but will not be sensitive enough for feedwater purposes. Should the conduit be shaped so that a vortex is formed, a sensitive meter may be constructed so as not to be greatly affected by fluctuations in pressure, for the inertia of the vortical mass will serve to steady the gage readings much as a flywheel does the motion of an engine. The sensitiveness of the meter can be changed by moving the low-pressure vent along a radius of the vortex, and the author shows that the meter can be made to give in this way correct results for any particular temperature, so that the meter would be self-compensating, within certain limits, through causing the low-pressure vent to be moved by an unequal expansion arrangement. The possibility of doing that is proved analytically.

To test the correctness of theory, two models were constructed and tested. The first, constructed for the purpose of determining the variation of pressure along an element of surface of the vortex and along the axis, has shown that the first is practically constant until the outlet of the chamber is nearly reached, and that the second is about constant until the top is closely approached, which indicated that the vents do not need to be placed with great accuracy if they are located in a certain way, and that the meter readings will not be greatly influenced by a slight distortion of the entering stream lines.

The second model was designed to give a linear flow in the outlet, and to allow the low-pressure vent to be moved in a radial direction; there being provided, in addition to the vortex chamber, a second chamber which the water enters from the vortex chamber with a whirling motion, and leaves tangentially. The author made a series of tests with this model, and found, among other things, that the loss of head with the vortex meter in the model is greater than with the venturi meter, but the former is $3^1/_2$ times as sensitive as the latter. By means of a calibration curve he found an equation connecting the meter head with the velocity, the former being proportional to a higher power of the latter than the square, and also found an expression for the ratio of meter head over loss of head through the meter in terms of velocity. Further tests have shown that the error introduced by changing temperature is proportional to the temperature change, and that a slight motion of the thumb-screw, such as can easily be given to it by an unequal expansion arrangement, will suffice to give correct results at all temperatures. He describes such an arrangement of two elements made of invar steel and zinc respectively.

The recording device proposed by the author is described and the mathematical principles underlying its operation presented.

A NEW VOLUME REGULATOR FOR AIR COMPRESSORS

By Ragnar Wikander

After a review of the previously existing types of volume regulators or "unloaders," the author explains the basic principle and method of operation of the new device, which regulates the amount of intake air for air compressors with automatic or poppet type of valves.

In order to decrease the amount of intake air, the suction valves are kept open by force during a part of each discharge period, thereby allowing a part of the air which has been drawn into the cylinder during the suction period to return through the valves, and close as soon as the amount of intake air remaining in the cylinder has decreased so as to correspond to the amount of compressed air required at the time.

The method whereby the closing of the automatic valves at an adjustable point during the return flow of the air or gas is effected, consists simply in a very gradual regulation of the force holding the valves open against the pressure exerted by their springs.

The return flow of the elastic fluid through the valves produces a pressure tending to close them and this pressure constantly increases until the piston has reached the end of its stroke, or very nearly so. The valve will close at the point where this pressure, supported by the pressure of the valve springs, balances and overcomes the force applied for the purpose of regulation.

The application of this regulator to a standard Hall air compressor is illustrated and indicator diagrams show the working of the device. The advantages obtained by application to natural gas compressors are also explained.

THE CLINKERING OF COAL

By Lionel S. Marks

There is a growing feeling that the matter of clinkering ought to be taken care of when making contracts for coal and it is frequently suggested that specifications ought to include the melting temperatures of the ash as indicating the clinkering characteristics of the coal. A number of investigators have been working on this subject and it is in

the hope of bringing out such information as is available that this paper is presented.

The principal difficulty in the determinations of the melting temperature of an ash, is in the definition of melting temperature. An ash is usually composed of a number of constituents of different fusibilities and viscosities. The only method that seems to be available for measuring both melting temperature and viscosity, is the Seger cone method, or some modification of it. It is a rough method of measuring the temperature at which the ash reaches a standard viscosity. The method fails if the most fusible constituents of the ash are very fluid, as a skeleton of the cone may be left standing long after its more fusible constituents are quite fluid. If the cone is placed horizontally projecting over the edge of its support, the indications are more satisfactory, though still far from perfect.

The Seger cone method as carried out in various laboratories, yields results which are extremely variable. A tabulation of such results shows an extreme variation of as much as 700 deg. fahr. between different laboratories. An investigation of the causes of this variation shows that the most important factors are the kind of atmosphere and the rate of heating. If the melting takes place in a reducing atmosphere, the observed temperatures will be from 250 to 450 deg. fahr. higher than in an oxidizing atmosphere. The rate of heating the cone has a marked effect on the apparent fusing temperature, when a thermo-electric pyrometer is used.

Laboratory tests of coal ash by the method finally adopted by the writer when compared with the clinkering results actually observed when burning ten different coals under normal power house conditions, show a general relation between the two, but not definite enough to be reliable.

A further indication obtained from the ash tests seems to be of value when combined with melting temperature observations. This indication is the appearance of the melted cone and the range of temperatures between initial and final bending of the cone. The coals which gave most trouble were also those of which the ash cones showed a very liquid constituent and a small range of temperatures between initial and final bending. For the particular boiler plant investigated, it would seem that an ash with a fusing temperature below 2550 deg. fahr. will probably give trouble if the ash cone shows a fusible constituent; whereas it will not give trouble with a fusing temperature above 2515 deg. fahr. if the ash is viscous.

PHYSICAL LAWS OF METHANE GAS

By P. F. Walker

Methane is the leading element in natural gas from the mid-continental field and its behavior is essentially that of the gas as handled in the pipe lines. The paper starts with data which show values of PV as a product, and of specific heat. From these data are derived equations for isothermal, P-constant, V-constant, and adiabatic curves, all showing consistent variations from the standard equations for perfect gases. It is shown that in certain calculations these variations from the perfect gas laws are sufficient to cause significant errors in computation of equivalent volumes of gas as handled on a commercial scale. It is pointed out that the inadequacy of data of a fundamental sort and conflicting statements of various authorities as to specific heat, make necessary more extensive investigations on the non-perfect gases before the work can be extended to give positive correction factors to use in practice.

LABORATORY FOR INVESTIGATING AND TESTING LIQUID FLOW METERS OF LARGE CAPACITY

By W. S. Giele

The paper develops a general method for testing and calibrating liquid flow meters by means of direct comparison of like quantities as volumes, inches of water head, and rates per unit time, and describes in detail the construction of a laboratory for conducting experiments by this method.

The main portion of the apparatus is contained in a three-story building. Essentially, it consists of a sump tank holding about 1000 cu. ft. of water, from which the water is elevated by means of a turbine-driven centrifugal pump to a constant head tank on the roof of the building. Thence it flows to the standard notch tank which is the standard of measurement for the laboratory. It contains a calibrated V-notch weir and is supplied with a hook gage, water-jacketed to maintain uniform temperature and provided with means for distant magnified observation. This standard notch tank is supported directly from the foundation, independent of other parts of the structure.

From the standard notch the water may be made to pass to either of two volumetric tanks, having a capacity of 525 cu. ft. each, or to a meter under test.

As the capacity of the plant is 110 cu. ft. of water per minute (approximately 412,500 lb. per hour) the large size and range of the various elements necessitated unusual precautions in construction and what is believed to be an original method of centralizing observation and control, minimizing the probabilities of error.

In connection with the detailed description of each element of the plant, original data of calibration and computation of possible error are presented.

The paper concludes with an outline of the method of conducting a typical test and shows a sample log sheet for such a test.

OTHER FEATURES OF THE MEETING

It is expected that on Wednesday evening the John Fritz Medal will be awarded to Prof. John E. Sweet, Honorary Member and Past-President of the Society, to whom more than to any other living man the formation of the Society is due. It was Professor Sweet who, encouraged by Henry R. Worthington and Alex. Holley, visited the principal engineers and worked up the idea which resulted in the first meetings in the offices of the American Machinist and at Stevens Institute of Technology.

It is planned to follow the presentation with an address, but the subject cannot as yet be definitely announced. It is anticipated that it will be one of unusual interest to the engineering profession.

An important phase of the meeting will as usual be the social events and the New York Local Committee will again have charge of these features. The President's Reception will be given on Tuesday evening, December 1, in the rooms of the Society on the eleventh floor of the Engineering Societies Building. The re-

union will this year take the form of a dinner dance and will be held at the Hotel Astor, where the grand ballroom has been engaged for the occasion. Covers will be laid for 350 and there will be dancing between courses. This will constitute the chief social event of the meeting, but there will in addition be several affairs planned by the Ladies Committee.

COUNCIL NOTES

At a meeting of the Council on October 9, 1914, the general subject of the Boiler Code was discussed and Alex. C. Humphreys, E. B. Katte and I. E. Moultrop were appointed a special committee to draft a resolution for consideration of the Council, covering action to be taken on this report. The resolution which was adopted requested the Boiler Code Committee to prepare a reprint of their preliminary report and give all other committees from this and other societies with whom they have conferred full opportunity to concur therewith or submit objections thereto. After this procedure, the committee are requested to report to the Council for its further action.

It was voted that the support of the International Engineering Congress be continued and that every effort be made to make the congress a success.

The action of the Council at its June meeting with regard to discontinuing the publication of Condensed Catalogues was rescinded, and it was voted to continue the volume for the present year. The publication of Transactions for 1914-1915 was also authorized. The Publication Committee was given authority to issue the History of the Society by subscription.

The report of the Committee on the Standardization of Flanges was ordered published in Transactions.

The following appointments were made on sub-committees: Added to the Air Machinery Committee, O. P. Hood, C. C. Thomas, V. C. Bachelder, F. A. Halsey; on the Textiles Committee, Albert C. Duncan and W. E. Hooper, in place of John Eccles, deceased, and H. F. Mansfield, resigned; on the Machine Shop Practice Committee, H. P. Fairfield, H. M. Lucas, R. E. Flanders, in place of those whose terms of office have expired. The formation of a new committee on Protection of Industrial Workers was approved, John H. Barr, chairman; also the appointment of a sub-committee on Fuel Oils of the Research Committee.

The following appointments on local committees were approved: New Haven, H. B. Sargent, chairman, and J. A. Norcross; Buffalo, David Bell, chairman; Los Angeles, W. H. Adams, chairman, F. W. Harris, W. W. Smith, O. J. Root, Paul Weeks.

The establishment of a student branch at the Colorado State Agricultural College, Fort Collins, Colo., was approved, as well as the appointment of Wm. H. Kavanaugh as Honorary Chairman of the Student Branch of the University of Minnesota.

Calvin W. Rice, *Secretary.*

REPORT OF SPECIAL NOMINATING COMMITTEE

In accordance with the provisions contained in C-48 and B-28 of the Constitution and By-Laws of the Society, George J. Foran, of New York, has been nominated as Manager, to fill the unexpired term of the late Alfred Noble, by a Special Nominating Committee composed of the following members:

W. H. Norris, F. E. Sanborn, M. S. Hopkins, S. G. McMeen, E. A. Hitchcock, E. B. Katte, W. G. Carlton, R. B. Kendig, C. Schwartz, A. C. Humphreys, A. S. Miller, W. H. Wiley, H. G. Stott, E. G. Marble, R. J. S. Pigott, C. F. Dixon, A. R. Baylis, E. S. Cooley, D. S. Jacobus, R. M. Dixon, C. W. E. Clarke, N. Cheney, W. N. Cargill, W. Goodenough, E. B. Powell, G. L. Knight, C. F. Bancroft, E. Smith, J. H. Libbey, B. R. T. Collins, R. Hutchison, A. C. Ashton, C. W. Hunter, F. A. Mazzur, C. H. Bartlett, F. S. Clark, F. N. Bushnell, A. C. Eckert, C. H. Peterson, J. Laichinger, J. F. G. Miller, E. Flad, C. T. Westlake, J. Hunter, G. C. Vennum, E. H. Tenney, W. H. Reeves, R. Skinner, G. B. Evans, L. A. Day, G. M. Peek, W. M. Duncan, W. S. Ashton, J. F. O'Neil, H. R. Setz, A. T. Vick, M. Rotter, R. Schlatter, J. A. Whitlow, H. L. Lowe, J. H. Boughton, W. C. Morehead, C. H. Fish, W. G. Snow, C. A. Read, F. H. Hayes, D. K. Bartlett, F. N. Connet, A. F. Clarke, R. E. Hall, S. B. Paine, A. W. Parker, C. I. Pearson, G. P. Aborn, J. C. Long, W. E. Choate, W. W. Blakeman, L. S. Marks, G. C. Anthony, C. H. Chase, H. B. Gale, W. D. Ford, F. R. Brosius, P. P. Bird, H. E. Troutman, R. A. Widdicombe, W. O. Moody, L. P. Streeter, M. T. Kimman, O. G. Kelly, F. A. Lindberg, C. C. Douglas, J. E. Lord, P. A. Poppenhusen, A. G. Burke, Jr., R. W. Allerton, E. B. Ellicott, C. J. Bacon, C. W. Naylor, D. H. Maury, C. H. Wheeler, Jr., C. F. Drake, C. R. Birdsey, E. W. Lindquist, A. L. Fitch, W. L. Abbott, P. Junkersfeld, J. W. Bancker, D. A. Wallace, W. F. Hendry, F. L. Gilman, H. F. Albright, F. H. Dorner, J. Todd, J. C. W. Greth, J. N. Chester, F. W. Casler, J. F. Diepenbrock, J. M. Graves, B. W. Burtsell, M. W. Taber, W. S. Russell, D. T. Randall, J. A. Vail, J. W. Brown, J. G. Vincent, J. Kahn, H. D. Church, C. H. Taylor, E. J. Stoddard, A. Dow, H. H. Esselstyn, C. M. Barber, J. B. Mansfield, W. S. Conant, F. C. Osborn, R. T. Wingo, C. E. Sweet, H. S. Hodge, L. C. Tenney, H. V. Conrad, T. E. Coon, H. M. Leland, E. E. Sweet, C. M. Carson, W. C. Leland, L. K. Snell, G. H. Layng, F. Johnson, T. H. Kane, G. A. Orrok, C. B. Grady, C. C. Worth, W. J. Best, F. D. Herbert, W. F. Monaghan, F. E. Idell, R. P. Bolton, W. H. Bradley, H. S. Isham, O. H. Fogg, M. W. Kellogg, G. W. Martin, S. D. Sprong, C. K. Nichols, A. W. H. Griepe, F. T. H. Bacon, E. G. Munson, H. F. Kellemen, F. W. Heisler, T. E. Murray, L. P. Breckenridge, J. P. Sparrow, W. T. Donnelly, H. L. Aldrich, D. Farrand, N. A. Carle, E. B. Meyer, H. S. Vassar, V. M. Frost, H. Webster, N. S. Slee, P. C. Idell, F. A. Scheffler, E. H. Peabody, E. Mills, H. C. Inslee, W. A. Jones, G. A. Gulowsen, A. P. McClintock, A. W. Smith, W. L. R. Emmet, A. A. Adler, C. T. Schreiber, W. J. Keep, A. C. Wood, T. C. McBride, H. E. Ehlers, J. E. Gibson, H. Hess, W. R. Jones, R. R. Yarnall, A. C. Jackson, T. H. Hinchman, R. Collamore, C. R. Richards, R. S. Allyn, E. C. Lufkin, C. R. Place, J. W. Smith, E. H. Dewson, H. P. Barr, E. H. Mumford, R. H. Kirk, T. Stebbins, W. W. Erwin, H. E. Coffin, L. C. Rogers, S. G. Barnes, E. H. Bingham, W. E. Snyder, A. F. Backlin, E. T. Peterson, J. A. Hunter, E. K. Hiles, C. J. Angstrom, W. P. Hayes, J. R. Fortuin, F. B. Bigelow, F. W. Kelley, W. J. Fullerton, J. F. McElroy, L. L. Brinsmade, F. C. Armstead, H. M. Lane, A. L. Jenkins, J. D. Lyon, S. G. Pollard, C. H. Anderson, B. L. Baldwin, G. W. Simpkinson, W. H. Blauvelt, F. B. Klock, J. M. Flannery, C. K. Mallory, H. E. Dunkle, E. N. Trump, E. A. Barnes, C. L. Griffin, B. N. Bump, W. E. Hopton, F. Pillmore, T. H. Miller, L. A. Zöhe, E. W. King, R. M. Gordon, A. G. Mattson, G. B. Turnbull, I. E. Moultrop, S. Hosmer, A. B. Chamberlain, J. D. Andrew, R. E. Curtis, C. H. Parker, C. L. Edgar, H. N. Dawes, W. B. Snow, E. L. Clark, C. A. G. Winther, H. M. Latham, E. G. Bailey, F. W. Dean, F. B. Perry, W. A. Johnston, G. B. Haven, E. F. Miller, F. E. Shedd, H. V. Coes, F. W. Reynolds, C. T. Mosman, F. B. Cole, W. F. Uhl, C. B. Burleigh, F. Sargent, W. G. Ely, E. E. Gilbert, F. C. Pratt, O. Junggren, E. D. Dickinson, J. A. Capp, J. Riddell, A. L. Rohrer, R. H. Rice, S. A. Moss, G. M. Campbell, W. Johnson, H. S. Baldwin, A. D. Pentz, W. A. Hall, J. C. Parker, R. D. DeWolf, H. Harding, G. N. Saegmuller, C. L. Bausch W. D. Wishart, W. S. Austin, F. W. Lovejoy, W. H. Honiss, R. S. Riley, W. W. Bird, H. P. Fairfield, C. H. Manning, G. I. Rockwood, C. R. Seed, G. I. Alden, J. W. Higgins, W. D. Ennis, S. E. Weir, F. R. Still, S. N. Castle, F. F. Nickel, W. Schwanhausser, E. W. Greene, W. G. Hudson, W. Pressinger, W. M. Fleming, H. M. Chase, H. W. Morrill, C. L. Newcomb, C. G. de Laval, C. H. Jenness, S. M. Green, L. W. Graves, W. H. Damon, C. E. Bliss, B. A. Franklin, E. H. McClintock, R. Shirley, S. Stevens, G. W. Galbraith, L. G. Robinson, B. S. Hughes, W. G. Franz, C. H. Fox, J. T. Faig, W. Tallmadge, M. Coster, W. E. Moore, J. Kennedy, G. Mesta, F. L. Bigelow, A. Kingsbury, R. N. Ehrhart, H. T. Herr, C. B. Auel, F. S. Martin, W. P. Flint, F. B. Corey, E. W. McCallister, F. Hodgkinson, E. M. Herr, O. H. Bathgate, F. F. Harrold, E. R. Norris, C. W. Johnson, W. A. Bole, A. McIver, C. F. Uebelacker, G. W. Bacon, F. Blossom, H. H. Porter, A. B. Jennings, J. D. Bird, W. W. Ricker, A. P. Brockelbank, C. L. Cole, G. P. Symonds, H. H. Barnes, Jr., J. S. Smith, W. H. Boehm, S. G. Neiler, C. E. Wilson, E. P. Rich, H. B. Bryden, C. J. Davidson, D. Lofts, H. C. Gardner, W. S. Monroe, W. H. Traver, J. G. O'Neil, J. Lyman, J. L. Hecht, J. F. O. Stratton, H. M. Montgomery, F. Woodmansee, C. M. Garland, C. G. Y. King, C. M. Allen, J. J. Brown.

An account of Mr. Foran's career is appended herewith:

GEORGE J. FORAN

George J. Foran was born in Boston, Mass., January 22, 1862, and was graduated from the Massachusetts Institute of Technology in 1883. His thesis was a history of the art and design of pumping machinery. Upon graduation, he entered the employment of The Deane Steam Pump Company, leaving them at the end of three years to go with the George F. Blake Manufacturing Company, with which company he was associated at the time of its amalgamation with the International Steam Pump Company. After a brief experience in the shop, he served as salesman in the engineering field for some years, later acting as consulting engineer to the president and treasurer of the Blake Company, with special reference to engineering design and constructing water works, condensing and air compressor installations, tests and investigations in New England. Upon the completion of the new Blake Works at Cambridge, he became its office manager and head of the estimating and cost department, originating the cost system then installed. Later he returned to the engineering sales department, and in 1900 went to New York and has since been manager and chief engineer in responsible engineering charge of the condensor department of the International Steam Pump Company, also serving as consulting engineer in the products of its various allied companies. He was active in originating and designing high vacuum apparatus in its development stage, and was responsible for the design of many installations, including a large number of the important installations of this type in the United States.

Mr. Foran joined the Society in 1887 as a junior, and was promoted to member 1893. He was a member of the Membership Committee of the Society for six years, and of the House Committee for three years.

He is also a member of the Verein deutscher Ingenieure and the American Association for the Advancement of Science and an associate member of the American Society of Naval Engineers. He has done a large amount of original investigation and study in the several fields of mechanical engineering and has occasionally contributed to the various publications and society transactions.

RESOLUTIONS OF THE COUNCIL ON THE DEATH OF ALFRED NOBLE

In the death of Mr. Alfred Noble, the engineering profession has lost one of its greatest members, one of its wisest associates, and one of its most modest scientists.

Mr. Noble was a man of generous impulses, always interested in the success of younger engineers, always ready to help them with advice, and to put before them an opportunity for their success. He was without the slightest professional jealousy, and so in love with his chosen calling that he always hailed the achievements of others with delight because engineering had by them been advanced and the world benefitted. His personality was most charming and The American Society of Mechanical Engineers will long miss his delightful talks and wise advice at its Council meetings, where he was a most welcome member. He may be aptly described as a lovely man, full of gentleness and dignity, and yet possessing a forceful character which fitted him so well as a cherished adviser.

It may not be generally known that Mr. Noble had an influence in the decision of Congress to abandon the sea level plan and adopt the lock system for the Panama Canal. The subsequent events have shown the wisdom of Mr. Noble's advice. A member of Congress and a personal friend of Mr. Noble asked him to state his reasons for advising the lock system in the form of a letter. This was done in a most concise form and was read in the House of Representatives, and thus became incorporated in the Congressional Record, with the result that it convinced the members, and by a large majority they adopted the lock system. Copies of the Record marked at Mr. Noble's letter were given to each Senator, and the argument was equally convincing, so that the Senate confirmed the House action by a large majority.

A glance at Mr. Noble's history will be most edifying to a young engineer as it will be gratifying to his hosts of friends. He was born August 7, 1844, at Livonia, Wayne County, Michigan, where his parents, Charles and Livonia (Douw) Noble, resided on a farm. His grandfather served in the War of 1812, and his ancestors were in the Revolutionary War. His early education was received in the District School of his native place, and during his spare time he worked on his father's farm.

In 1862, when only 18 years of age, he enlisted in the Civil War in the 26th Michigan Volunteer Infantry. From that time until 1865 he served in the Army of the Potomac, taking part in all of the hard and desperately fought battles which that army engaged in against Lee and Stonewall Jackson. At Gettysburg his regiment lost a very large percentage of its numbers. At Chancellorsville, it was by the merest accident that his brigade was not captured by Stonewall Jackson men, but he was lucky in serving through the war without being wounded, and was mustered out of the service in June 1865, with the rank of Sergeant. He then prepared to enter the University of Michigan, and in 1867 became a sophomore, graduating in 1870 with the degree of C. E. He received the degree of LL.D. from his Alma Mater in 1895, also from the University of Wisconsin in 1904.

From 1868 to 1870 he was assistant engineer on river and harbor work on the Great Lakes. From 1870 to 1872 he was in charge of improvements on St. Mary's Falls Canal and St. Mary's River. During this time the first great masonry lock at the Soult, then by far the largest canal lock in the world, was built.

On completion of this work he became resident engineer on the construction of an important bridge at Shreveport, La., over the Red River.

From 1883 to 1886 he was general assistant engineer of the Northern Pacific Railroad.

From 1886 to 1887 he was resident engineer on the construction of the Washington Bridge over the Harlem River, New York City, at that time the largest arch bridge in existence.

From 1887 to 1894 he was resident engineer on the construction of several very large and important bridges over the Mississippi at Memphis and Alton, over the Missouri at Bellefontaine and Leavenworth, and over the Ohio at Cairo.

He was appointed a member of the Nicaragua Canal Board by President Cleveland in 1895. This Board visited Central America and examined the route of the Nicaragua Canal and also the Panama Canal and then returned to the United States, completing its work November 1, 1895.

In June 1899, he was appointed by President McKinley a member of the Isthmian Canal Commission, which was charged with the selection of the best canal route across the American Isthmus, and it has been substantially on the route selected by this Commission that the Panama Canal has been constructed. While on this Commission, Mr. Noble with his colleagues visited Europe to examine the existing canals there and to investigate the data which the French Canal Company had in Paris, and also made several trips to Central America to look more fully into the various canal routes.

In 1905 he was appointed by President Roosevelt a member of the International Board of Engineers to recommend whether the Panama Canal should be constructed as a sea level or a lock canal. This Board consisted of thirteen members, of whom five were nominated by foreign governors. Mr. Noble was one of the minority of five Americans who recommended the adoption of the lock plan. Their views were adopted by the Government, and the Canal has been built in accordance with their recommendations.

In March 1907, he was one of the three appointed by President Roosevelt to visit the Panama Canal to investigate the conditions regarding the foundations of some of the principal structures. This duty was completed in a few weeks. He was obliged to decline a similar appointment two years later.

From the very inception of the plan by this country to build an isthmian canal, and from the commencement of the preliminary investigations and surveys, to the adoption of the final plan, and the commencing of the actual construction of the Panama Canal, Mr. Noble was continuously identified with the project and deserved as much credit for the solution of the engineering problems as any other one who has been connected with this great work.

In July 1897, he was appointed by President McKinley a member of the U. S. Board of Engineers on Deep Water Ways which made surveys and estimates of cost for a ship canal from the Great Lakes to deep water in the Hudson River.

In November 1901, the city authorities of Galveston, Texas, appointed Alfred Noble, along with Henry C. Ripley and General Robert, as a Board of Engineers to devise a plan for protecting the city and suburbs from future inundation. They recommended the building of a solid concrete wall over three miles long and seventeen feet in height above mean low water, the raising of the city grade, and the making of an embankment adjacent to the wall; the whole to cost about three and a half million dollars, which plan has since been carried into effect.

From 1902 to 1909 Mr. Noble was chief engineer of the East River Division of the New York extension of the Pennsylvania Railroad, and was in entire charge of this most difficult piece of work, involving, as it did, a very accurate survey across Manhattan, and the construction of the foundations of the Pennsylvania Station, of the land tunnels and of the East River tunnels, which were very troublesome.

Since 1909 he engaged in general practice as a consulting engineer, the firm name being Noble and Woodard. Probably the most important work dealt with was in relation to the dry docks built for the United States Government near Honolulu. He was also, for a time, Consulting Engineer to the Quebec Bridge Board, also Consulting Engineer for the Board of Water Supply, New York City, and for the Public Service Commission of the First District of the State of New York.

He has been Past President of the Western Society of Engineers, American Society of Civil Engineers, and American Institute of Consulting Engineers.

In 1910 he was awarded the John Fritz Medal for "notable achievements as a Civil Engineer."

In 1910 he was elected an Honorary Member of the Institution of Civil Engineers of Great Britain, a distinction which no other American has ever received.

In 1912 he received the Elliot-Cresson Medal of the Franklin Institute "in recognition of his distinguished achievements in the field of Civil Engineering."

He was married May 31, 1871, to Miss Georgia Speechley, of Ann Arbor, Michigan. They had one son, Frederic Charles, a graduate in Engineering of University of Michigan, 1894, now following his profession in New York City.

There is little to add to this epitome, but it shows the forceful character of Mr. Noble throughout. He won the various honored and honorable positions he so ably filled by merit and perseverance, and his career, cut short in this untimely manner, is an encouragement to every young engineer and a stimulus to the exercise and cultivation of those manly and fearless qualities in the possession of which Mr. Noble so excelled and which have so firmly established him in the affections and admiration of all engineers.

APPLICATIONS FOR MEMBERSHIP

Members are requested to scrutinize with the utmost care the following list of candidates who have filed applications for membership in the Society. These are sub-divided according to the grades for which their age would qualify them and not with regard to professional qualifications, i.e., the age of those under the first heading would place them under either Member, Associate or Associate-Member, those in the next class under Associate Member or Junior, while those in the third class are qualified for Junior grade only. The Membership Committee, and in turn the Council, urge the members to assume their share of the responsibility of receiving these candidates into the Membership by advising the Secretary promptly of anyone whose eligibility for membership is in any way questioned. All correspondence in regard to such matters is strictly confidential and is solely for the good of the Society, which it is the duty of every member to promote. These candidates will be balloted upon by the Council unless objection is received before December 10, 1914.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE MEMBER

Anderson, Thos. D., Lecturer in Mech. Engrg., Sch. of Mines, Bendigo, Victoria, Australia.
Chapman, Wm. B., Pres., Chapman Engrg. Co., 11 Broadway, New York
Elberson, Leander P., Ch. Engr., La. Irrigation & Mill Co., Crowley, La.
Fichter, Clarence, Maintenance Engr., The Rike-Kumler Co., Dayton, Ohio
Fischer, Fred J., Ch. Mech. Engr., Los Angeles Dept. of Public Service, Los Angeles, Cal.
Friedlander, Max, 243 East 48th St., New York.
Grieve, Albert, Prof., Mch. Design, Lima Sch. of Mining Engrs., Lima, Peru, S. A.
Haigh, Gilbert R., Production Engr., Wm. Tod Co., Youngstown, Ohio.
Hermanson, Theo. H., Supt., Epping-Carpenter Pump Co., Pittsburgh, Pa.
Hessenbruch, George S., Asst. to Ch. Engr. of Pwr. Plants, Uuion Elec. Lt. & Pwr. Co., St. Louis, Mo.
Hopkins, Walter E., Ch. Engr., Coe Brass Branch, American Brass Co., Torrington, Conn.
Jana, Ashutosh, Cons. & Architectural Engr., Birulia, Haria P. O., Midnapur, Bengal, India
Kerr, Robert L., Engr. in Charge, Testing & Development, Alberger Pump & Condenser Co., Newburgh, N. Y.
McKnight, Wm. V., 310 Washington Ave., Oil City, Pa.
Nutter, Charles L., Treas., Old Colony Foundry Co., East Bridgewater, Mass.
Ogden, Wm. H., 78 State St., Binghamton, N. Y.
Percy, John C., Mech. Supt., Julius Kayser & Co., Brooklyn, N. Y.
Robinson, Wm., M. M., Eberhard Faber Pencil Co., Brooklyn, N. Y.
Rouband, Arthur, Genl. Foreman, Sao Paul Shops, Central Railroad of Brazil, Rio de Janeiro, Brazil
Sage, Darrow, Supt. of Pwr., Hudson & Manhattan R.R. Co., New York.
Schwarz, Michael, Supt., Schoenthaler Mfg. Co., St. Louis, Mo.
Smerling, Carl, 114 Hart St., Brooklyn, N. Y.
Spear, Lawrence Y., Vice-Pres., Electric Boat Co., Groton, Conn.
Tansley, John A., Plant Engr., with Wm. A. Rogers, Ltd., Niagara Falls, N. Y.
Winter, James M., Steam Boiler Inspector, Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

Esherick, George, Jr., Test Engr., American Engrg. Co., Philadelphia, Pa.
Fast, Gustave, Efficiency Engr., Crown Cork & Seal Co., Baltimore, Md.
Grady, Wm. H., Asst. Genl. Supt., American Creosoting Co., Louisville, Ky.
Hechler, Fred G., Instr. in Mech. Engrg., Rensselaer Poly. Inst., Troy, N. Y.
Kann, Gustav G., Designing Engr., with Arthur Pentecost, New York.
Lucey, Wm. S., Mech. Engr., Eastman Kodak Co., Rochester, N. Y.
McCollum, J. Grant, Supt. of Constr., New Essex Pwr. Sta., Public Service Elec. Co., Newark, N. J.
Miller, John H., Mech. Engr. with R. S. Kent, Designing Engr., Brooklyn, N. Y.
Root, Virgil A., Charge of Factory Ventilation, Natl. Lamp Wks., General Elec. Co., Cleveland, Ohio
Saurwein, George K., Designing Engr., Constr. Engrg. Dept., Edison Illuminating Co., Detroit, Mich.
Wright, Paul, Cons. Engr., 1104 Brown-Marx Bldg., Birmingham, Ala.

FOR CONSIDERATION AS JUNIOR

Benson, Harvey S., with H. C. Raynes, Inc., Cons. Engrs., Boston, Mass.
Camp, Wm. E., Task-setter & Investigator, Yost Typewriter Wks., Remington Typewriter Co., Bridgeport, Conn.
Crane, Eugene C., Supt. of Constr., Minnesota State Farm, St. Paul, Minn.
Ehrlich, Morris W., Pwr. & Designing Engr., Ives & Davidson, Cons. Engrs., New York.
Fairchild, Fred P., Draftsman, Equipment Dept., Stone & Webster Engrg. Corp., Cambridge, Mass.
Freeman, Clarke F., Industrial Engr., Remington Typewriter Wks., Ilion, N. Y.
Harris, Thos. W., Asst. to Wks. Steam Engr., Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Nadler, Harry A., Asst. Ch. Engr., Guanica Centrale Sugar Co., Ensenada, P. R.
Nissley, Warren W., Local Mgr., The Concord Gas Co., Concord, N. C.
Rosenfield, Harold, Draftsman, Edison Illuminating Co., Detroit, Mich.
Sengstaken, J. H., 497 Decatur St., Brooklyn, N. Y.

APPLICATIONS FOR CHANGE OF GRADING

PROMOTION FROM ASSOCIATE

Bruyere, Paul T., Cons. Engr., 50 Church St., New York

PROMOTION FROM ASSOCIATE-MEMBER

Cocks, Frank L., Special Designer of Automatic Mchy., Arbuckle Bros., Brooklyn, N. Y.

PROMOTION FROM JUNIOR

Beecher, Henry W., Mgr., Seattle Office, Chas. C. Moore & Co., and Babcock & Wilcox Co., Seattle, Wash.
Bourquin, James F., Genl. Mgr., Paige-Detroit Motor Car Co., Detroit, Mich.
Goetz, Victor J., Refrigerating Engrg., 345 N. 12th St., Philadelphia, Pa.
Katzenstein, Martin L., Mgr., Marine Dept., International Steam Pump Co., New York

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